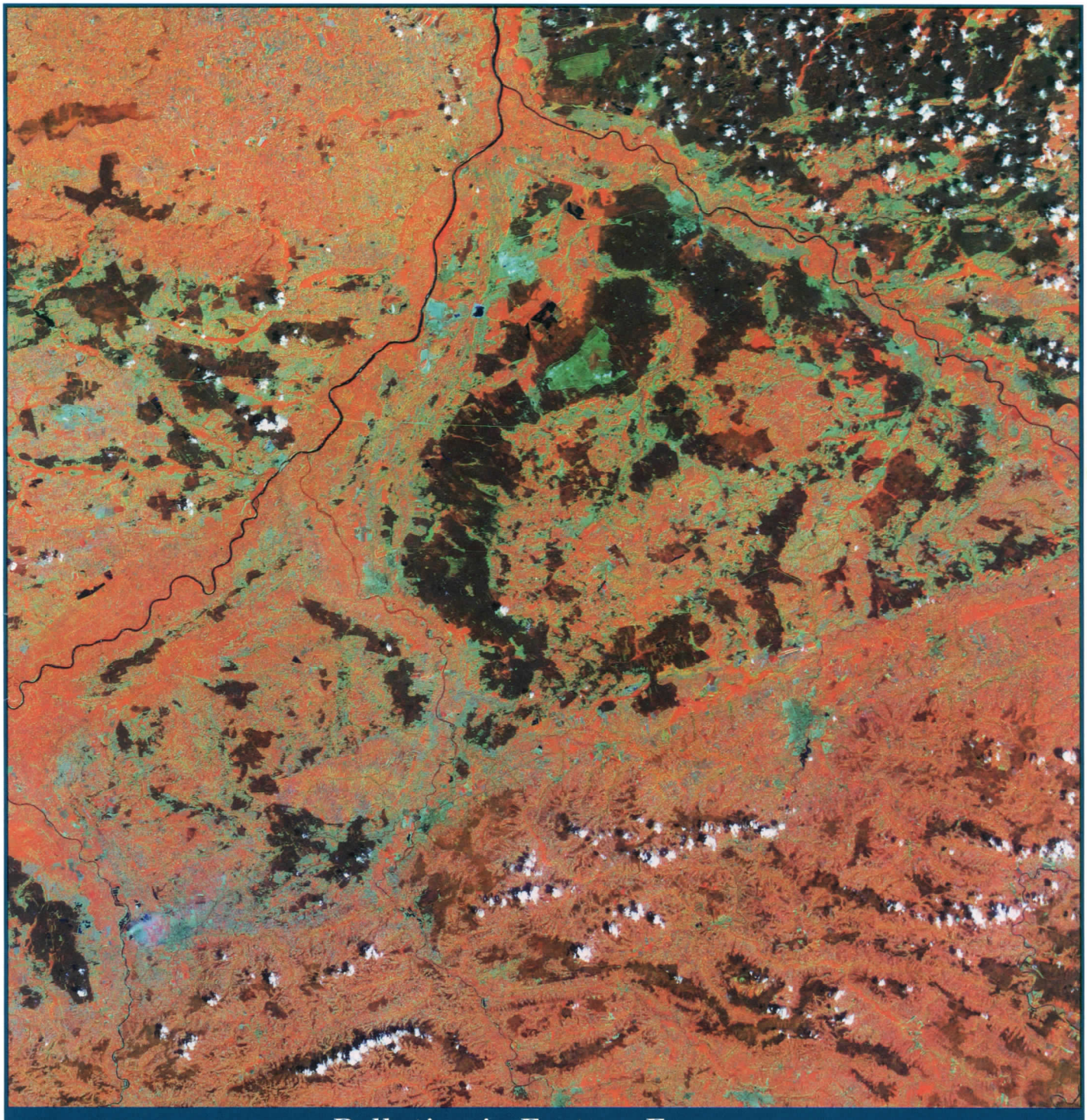
EOSAT®

Volume 6, Number 4 - Winter 1991

LANDSAT DATA USERS NOTES



Pollution in Eastern Europe

DOWNLINKS

Domestic, Foreign Companies Join EOSAT Network

EOSAT has expanded its network of sales representatives by signing on five companies in the United States and three abroad, bringing to 38 the total number of sales representatives around the world. EOSAT's global sales network was begun in October 1986.

The new North American sales representatives, based in Georgia, Michigan, California and Colorado, will be coordinated by Susan Sinclair. Ms. Sinclair is EOSAT's distributor network manager and the company's liaison to the value-added image processing companies. Until this year, EOSAT served U.S. customers through direct sales.

All of the new representatives have employed Landsat data in a variety of projects and can bring this experience to the aid of their clients. Steven Cox, EOSAT executive director of marketing and sales, noted that all have performed work outside their own nations. "This global sales network, in coordination with our direct sales management force," he said, "will provide more efficient service to EOSAT customers in North America and around the world."

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EOSAT Transfers Love, Cary, Williams

EOSAT has appointed Jim Love as director of NASA Programs, to serve as the company's liaison to NASA and other federal agencies involved in global change research. He has been associated with the Landsat program since 1971 and more recently was Customer Services manager at EOSAT.

In other appointments, EOSAT promoted Dr. Tina Cary from manager, public affairs, to director, applications and training. Ms. Vicki Williams has been promoted from applications specialist to manager, public information, formerly known as public affairs.

EOSAT Head to Speak at Montreux; Symposium Follows

Dr. Arturo Silvestrini, president of EOSAT, will speak at Space Commerce '92, the biennial worldwide meeting of the aerospace industry, in Montreux, Switzerland, March 23-26.

The Earth Space Institute will hold an international symposium on space data applications March 27-29 in Villars, Switzerland, immediately following the Montreux sessions. Information on symposium registration and speakers can be obtained from: OPA—ESR, 58 rue Lhomond, 75005 Paris, France; fax 33-1-47-07-15-26.

EOSAT Sponsoring Two March Events

The Earth Observation Satellite Company will hold a seminar and cosponsor a workshop on remote sensing in March.

On March 18-20, EOSAT will participate in a workshop on geology at the Texas Christian University campus in Fort Worth, Texas. Instructors will include members of the TCU faculty, and hands-on course materials will cover software and hardware commonly used in remote sensing and geologic mapping.

On March 30, EOSAT will conduct a seminar on the uses of remote sensing for renewable resource management, at the Hyatt Regency Tech Center in Denver, Colo. Value-added vendors will offer workshops on March 31.

For more information about the Denver and Fort Worth sessions, contact Max Khan or June Glover of EOSAT at 512-343-4513, (fax) 512-345-2924.

More States Buying Full TM Coverage

More than a dozen state governments have purchased complete Landsat coverage of their states, with three of them entering their orders in December. EOSAT's new State Coverage Program allows a state government to disseminate the Landsat data internally to any

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LANDSAT DATA USERS NOTES

The EOSAT Landsat Data Users Notes is a quarterly publication [ISSN 0896-7091] of the Earth Observation Satellite Company, and is published without copyright or other restrictions on copying. Articles highlighting applications of Landsat data are welcome, and should be submitted as double-spaced manuscripts with properly captioned illustrations. Written material, new product announcements, and information about meetings, symposia, workshops, and remote sensing training courses should be directed to:

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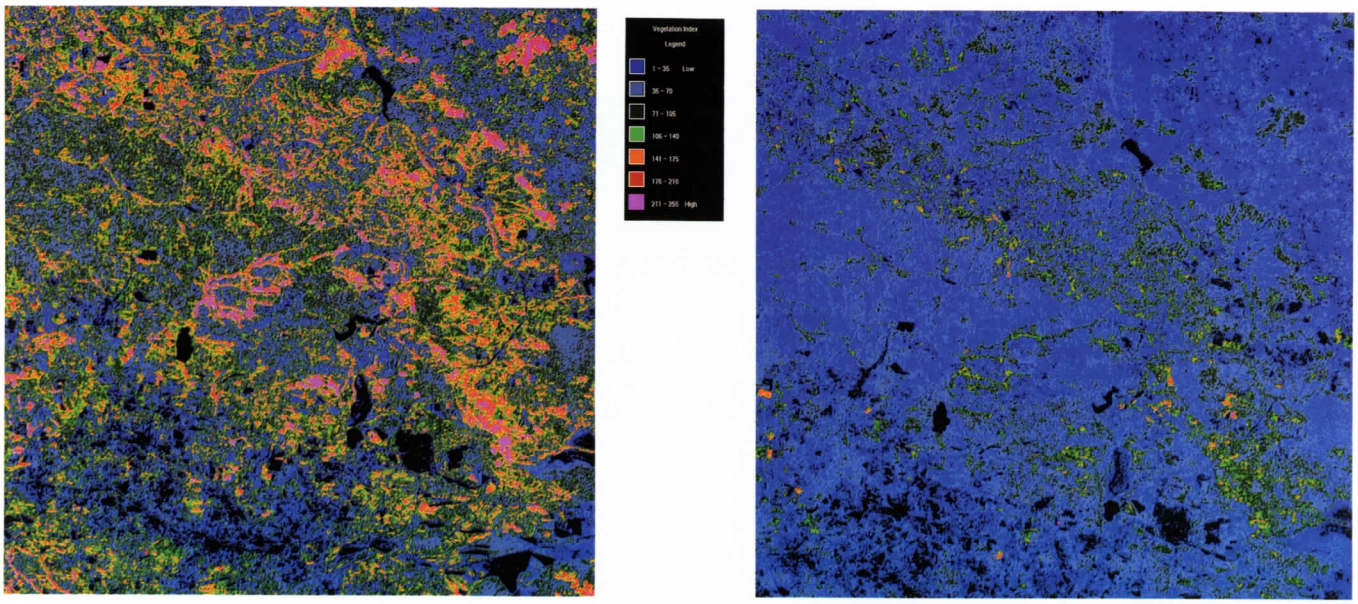


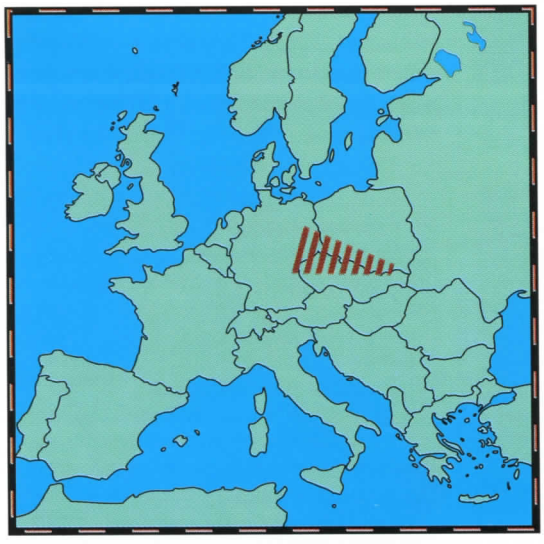
EarthSat study, MSS data

Dates of acquisition for this area of western Silesia are (left) August 6, 1981, and (right) September 22, 1989. Vegetative indexes using red and near-infrared bands are the basis of the images. Colors represent index values for biomass or vegetation vigor—red and pink are high values and blue represents low biomass. In the most recent image, there are far fewer red or pink vegetated areas. (Images courtesy of EarthSat.)

Measuring the Damage—Eastern Europe Prepares for Environmental Cleanup

In separate pilot studies, two U.S. organizations have been using Landsat data to measure environmental pollution in Eastern Europe. By making vegetation indexes in key areas hundreds of kilometers apart, they have documented the damage from 40 years of uncontrolled industrial pollution. These analyses, taking advantage of the multispectral and temporal capabilities of Landsat data, will guide restoration projects running into the next century.

The research teams are from the Earth Satellite Corporation (EarthSat) and the Institute for the Study of Earth, Oceans and Space at the University of New Hampshire (UNH). The EarthSat group studied the Silesia region of southern Poland on the border with Czechoslovakia, and the UNH team, working with an international group of scientists, is studying the Ore Mountains between Germany and Czechoslovakia and the Giant Mountains between Poland and Czechoslovakia. These areas are in the "dirty triangle" industrial region, atop a coal belt stretching across southern Poland, northern Czechoslovakia and eastern Germany.

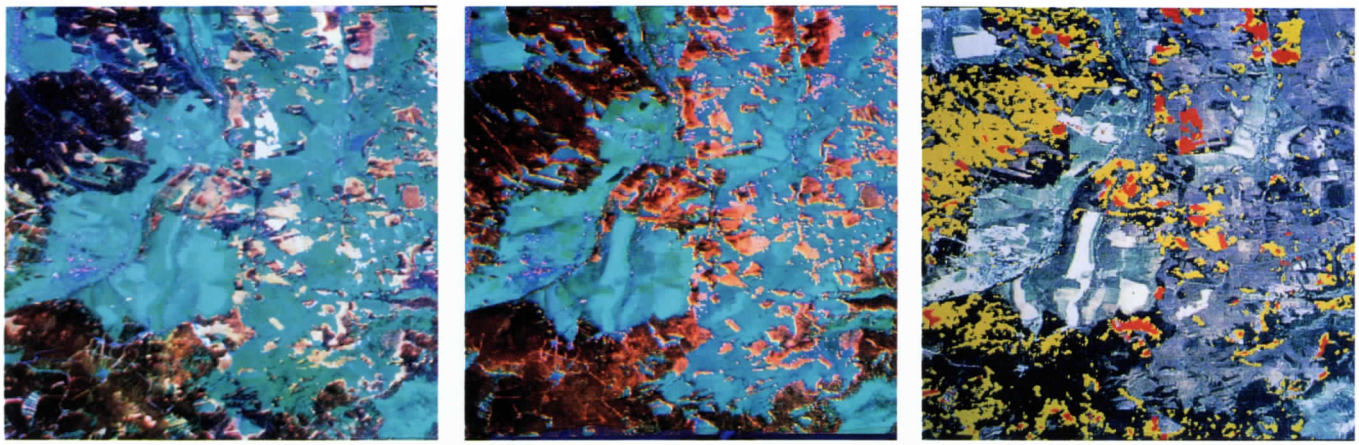


This map of Europe shows the approximate location of the area (stripes) known as the "dirty triangle."

The barometers for these environmental studies are mountain forests. Sick or dying trees on the slopes indicate high proportions of airborne pollutants from downhill industries. Tree health in turn can be appraised with Landsat data. Both teams turned this digital data into scene-by-scene vegetation indexes and compared the index values for different dates to chart the degradation. The researchers said the imagery costs represented about 25 percent of the total project expenses, which were about $50,000 each.

Environmental studies are often done with Landsat data. The Landsats capture data in spectral bands that are sensitive to plant vigor, including bands not measured by other satellites. They revisit the same geographic point 22 to 23 times a year, and they maintain data continuity with an archive nearly 20 years old, permitting studies of long-term change. Also, one Landsat image holds data about places as small as a football field, for areas as large as the country of Belgium.

Most of the forest damage in Eastern Europe has been thought to be caused by large power plants fueled by high-sulfur soft coal, facilities mandated by command economies seeking higher industrial production. The plants belch sulfur dioxide that harms vegetation as a gas and that mixes with water to form acid



University of New Hampshire study, TM data

In first image, taken September 30, 1985, heavily damaged conifers are light orange, moderately damaged conifers are dark orange, healthy conifers are dark brown, and clear-cut or dead trees are in blue areas. In the August 3, 1990, image (center), new clear-cut areas are the brighest. Dark patterns in blue areas are government reforestation sites. Other color codes are the same. Note 1985-90 shift from dark brown (healthy) to dark orange (moderately damaged) and from dark orange to light orange (severely damaged). The third image compares the 1985 and 1990 data, using band 3 for reference. Color codes show relative damage: red for severe loss, yellow for moderate loss and black for little or no change. (Images courtesy of Nancy Lambert, UNH.)

rain. Other airborne contaminants are the lead and oxides of nitrogen from vehicle exhausts. At one damaged forest in the Giant Mountains, reports UNH Associate Professor Barrett N. Rock, ground water was more acidic than lemon juice. The tree damage in the Giant and Ore Mountains, he said, has no counterpart in Western Europe or the northeastern United States.

To analyze the damage in the "dirty triangle," the UNH and EarthSat teams made vegetation indexes with reflected infrared data. The indexes document forest losses in different ways.

The UNH team is studying conifer tree damage by using data from Thematic Mapper (TM) bands 5 and 4. Healthy vegetation reflects in the near-infrared range measured by TM band 4, while absorbing energy in the shortwave infrared range measured by TM band 5. Damaged vegetation may decrease band 4 reflectance while increasing band 5 reflectance. An index using data from both bands in the same scene can indicate qualitative differences in tree health. Comparison of TM data from 1985 and 1990 showed a significant decrease in forest health in 44 percent of the conifer stands studied.

The images here provide damage assessments for an area of about 400 square kilometers in the Ore Mountain (Krusne Hory) forests near Bozi Dar in Czechoslovakia. The study is being conducted by Dr. Rock, Dr. James Vogelmann and Nancy Lambert of the University of New Hampshire, and Dr. Martin Sima of the Institute of Landscape Ecology of the Czechoslovak Academy of Sciences.

The EarthSat group, led by Margaret Mayers, has used both TM and Multispectral Scanner (MSS) data to analyze declining vegetation health over time. They compared values for the visible red bands and the near-infrared bands on the sensors because healthy plants absorb red light and strongly reflect near-infrared energy; a ratio of the two bands gives quantitative information about vegetative vigor. The area studied is the Silesia region, including the Katowice Province and part of the Vistula River. This region produces virtually all of Poland's coal, most of its steel, and about one third of its electricity. The most dramatic conclusion from the EarthSat study was a 50 percent decline in forest vigor between 1981 and 1989. The researchers estimated that some 200,000 acres of evergreen forest were dead or dying within Silesia alone. ❖

Photo: Barrett Rock, UNH

On Czechoslovakia-Poland border near center of "dirty triangle," Krkonose National Park is victim of air pollution. Polish foresters say trees died rapidly between 1978 and 1983.

Cover Photo: Upland forests of eastern Silesia, Poland, were already damaged (dark areas) when this Thematic Mapper image (path 187, row 25) was acquired on July 31, 1984. Rzeszow is below airfield in lower right quadrant; smokestack in lower left quadrant is outside Tarnow. Failure to control pollution in industrial areas has caused environmental havoc in Eastern Europe. TM bands 4, 7, 3 (RGB). (Image processed by Earth Satellite Corporation.)

Forest Database Helps in Cancer Fight

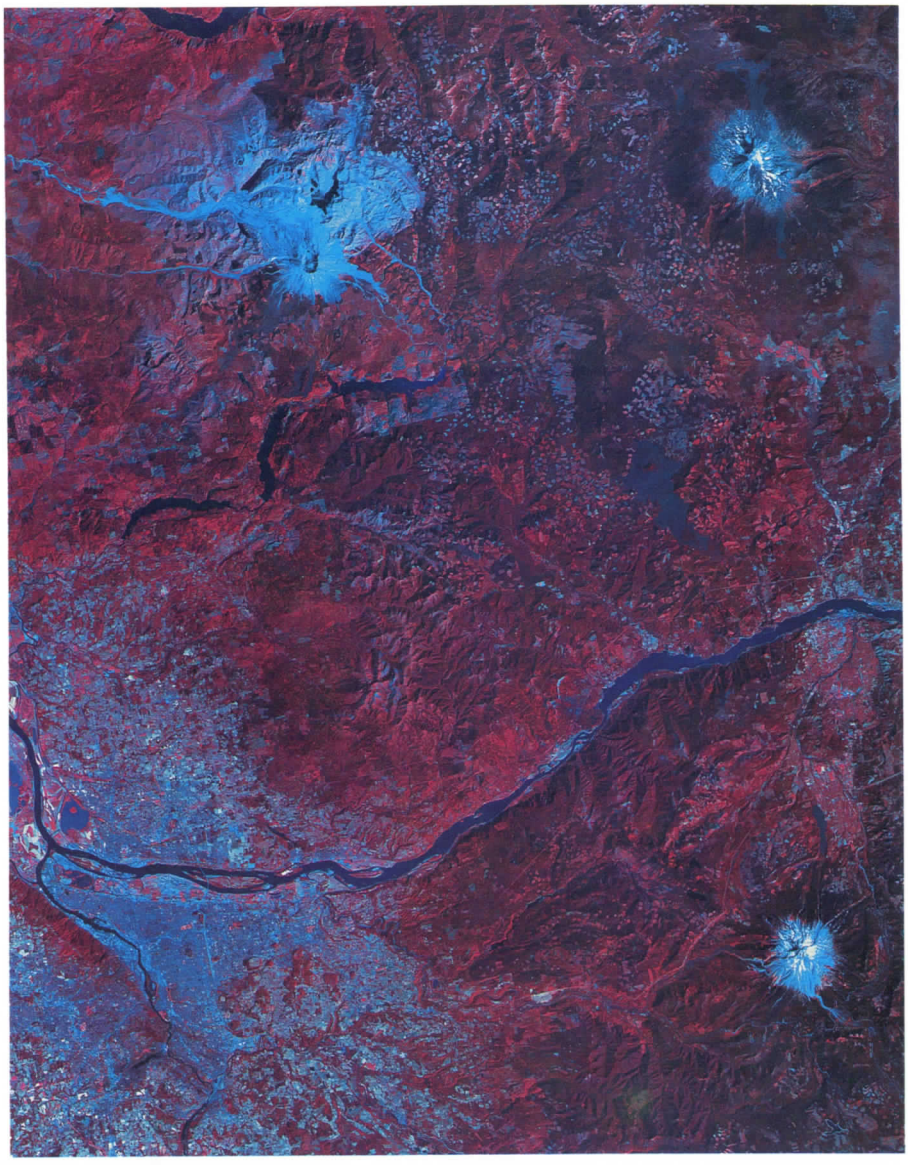
Using Landsat data, Pacific Meridian Resources has helped find trees that contain a cancer-fighting drug.

The hunt was conducted on a geographic information system (GIS) for the Pacific Northwest forest lands. The tree sought, the Pacific yew, is hidden by the forest canopy. Its bark is made into Taxol, an experimental drug that has successfully treated several types of cancer.

The GIS, built for the U.S. Forest Service by Pacific Meridian in 1989, has partial information on 30 million acres of forest in the Pacific Northwest. It has detailed data for 12.5 million acres of publicly owned forests and parklands. It links data on terrain, tree crown closure, tree species, current and historic vegetation distribution, hydrology, research and inventory sites, wildlife habitat, slope, aspect, elevation, ownership and other pertinent topics.

Pacific Meridian chose terrain-corrected Landsat Thematic Mapper (TM) data for the GIS. This product, incorporating relief data and ground control points, is EOSAT's top of the line, but the expense differential between this and the less costly system-corrected EOSAT digital data "was minuscule" for the advantages it offered, said Pacific Meridian President Kass Green. It enabled the company to integrate the Landsat data readily with data from sources such as aerial photos and old maps and it paved the way toward classification of the forest vegetation by size, class, species, structure and crown closure. By Green's estimates, the cost of the Landsat imagery is about one tenth of the total cost of the GIS plus the related projects that have been done since the database was built.

A major use of the GIS has been the identification of old-growth conifer stands. Protection and management of these undisturbed stands—occupying about 3.7 million acres of Northwest public land—has been hotly debated by timber companies and environmental groups. The GIS is also used for land-classification maps and for land-management models and to produce estimates about biological diversity in the forested areas.



Among other places, this section of national forests flanking Columbia River, east of Mount Saint Helens, harbored Pacific yew. TM Bands 4,3,2 (RGB)

Pacific Meridian and the Forest Service began the search for the yew after Bristol-Myers Squibb told the service it wanted to harvest 750,000 pounds of dry yew bark annually in 1991-93. At the time of the request, there was no inventory data on the Pacific yew because the Forest Service was tracking only trees considered commercially valuable.

Without a GIS, locating the Pacific yews would have involved time-consuming manual searches and compilations of records on the characteristics of the yew. The GIS linked the needed data into one file. Specialists from the Forest Service and Pacific Meridian did that, by identifying areas 1,500-4,000 feet above sea level, within a quarter-mile of lakes or streams, near Western hemlock trees, where more than 70 percent of the ground area is shaded by at least two layers of trees, and where at least 10 percent of the trees have diameters of 21 inches or more.

The database search was done in the spring of 1991. Bristol-Myers Squibb then completed its first harvest of yew bark in September. ❖

Applications Forum

A new feature in *Data Users Notes*, this section highlights uses of Landsat data in specific applications. To participate, send a brief overview of any project(s) for which you are using Landsat data. We will contact you before publication.

Geology

• TM images of western Canada are being analyzed for geologic features favorable for hydrocarbon exploration. David Currie, Bercha Group, Calgary, Alberta, (403) 270-2221.

• Using Landsat imagery and geochemical analysis, the Republic of Panama has located gold mines in central Panama, where no geologic maps were available. The mines are for sale. Alfredo E. Burgos, Dirección General de Recursos Minerales, Ministerio de Comercio y Industrias, Panama City, 561-36-1825/23.

Land Cover/Mapping

• Landsat data for open rangelands and agricultural areas is being studied to map wildlife habitat in southern Alberta, Canada. David Currie, Bercha Group, Calgary, Alberta, (403) 270-2221.

• Baltimore County, Maryland, is using Landsat imagery to classify forested areas and is compiling a geographic database on land use. Dale Johnson, Baltimore County Department of Environmental Protection and Resource Protection, Towson, MD (410) 887-3733.

• Landsat TM film products are being used to estimate ground water potential as part of a worldwide database of water resources, to be managed by the U.S. Army Corps of Engineers. Donald Vance, Greenhorne & O'Mara Inc., Greenbelt, MD (301) 982-2868.

For Landsat 7 Bill: Industry Support, February Markup by House Committee

The House Science, Space and Technology Committee expects to mark up a bill to amend the Landsat Commercialization Act of 1985 in late February, according to a Committee staffer. Under this timetable, the spokesperson said, the measure could reach the House floor for voting in March or April.

Committee Chairman George Brown of California introduced a bill to amend the act last October and held a hearing on it in November. This proposal, the Land Remote-Sensing Policy Act of 1991 (H.R. 3614), would authorize construction of Landsat 7 under an expedited procurement process and shift Landsat oversight from the National Oceanic and Atmospheric Administration (NOAA) to a "joint program office" (JPO) to be administered by the National Aeronautics and Space Administration (NASA) and the Defense Department. The Brown bill also would establish a two-level pricing structure: Domestic nonprofit users and government agencies in the United States would pay only the marginal costs of acquiring and distributing Landsat data, while all other buyers would pay the full commercial price. The bill specifies that Landsat 7 be a near copy of Landsat 6 (which will be launched this year), but Rep. Brown has suggested adding a device to capture stereoscopic imagery at 5-meter resolution.

EOSAT has built and will operate Landsat 6. It will have the same orbit and provide the same seven bands of Thematic Mapper data as Landsats 4 and 5. In addition, it will have a panchromatic band spanning the electromagnetic wavelengths from visible to near infrared, at 15-meter spatial resolution. The projected operating life of Landsat 6 requires that construction of Landsat 7—postponed several times by federal budget-makers—be accelerated to avoid creating a gap in the Landsat data, which has been collected continuously since 1972.

Just before the November hearing, the interagency National Space Council endorsed the concept of the JPO and announced that the Administration would seek funds in fiscal year 1993 to build Landsat 7. At the hearing, NASA and Defense representatives said they could work out details of the administrative and financial support for designing and building Landsat 7.

Other witnesses at the hearing urged a rapid start on Landsat 7 and voiced opposition to the two-tiered pricing structure proposed in the Brown bill. Some suggested alternatives for making Landsat data available to researchers at lower cost, such as data grant programs or "information vouchers." Several witnesses noted that EOSAT has a contract to market and process Landsat data and said the company must be allowed to make a profit on its operations. In response to questions about Landsat prices, witnesses told Committee members that Landsat data is a bargain, usually accounting for only a small percentage of total project costs. ❖

Landsat 6 Update

The assembly of the spacecraft modules into the Landsat 6 flight configuration was completed by year-end 1991. The satellite is planned for launch in 1992.

Landsat 6 is at the East Windsor, N.J., plant of General Electric Astro Systems Division. Tests to be completed in the first quarter include the payload initial power turn-on, the end-to-end test and environmental testing.

At right, a quality-control specialist checks the Enhanced Thematic Mapper, the payload for Landsat 6, at the Santa Barbara (Calif.) Research Center of Hughes Aircraft, where ETM was built. The ETM will add a high-resolution panchromatic band to the line of Landsat data products. ❖

International Sales Representative Feature: GAF

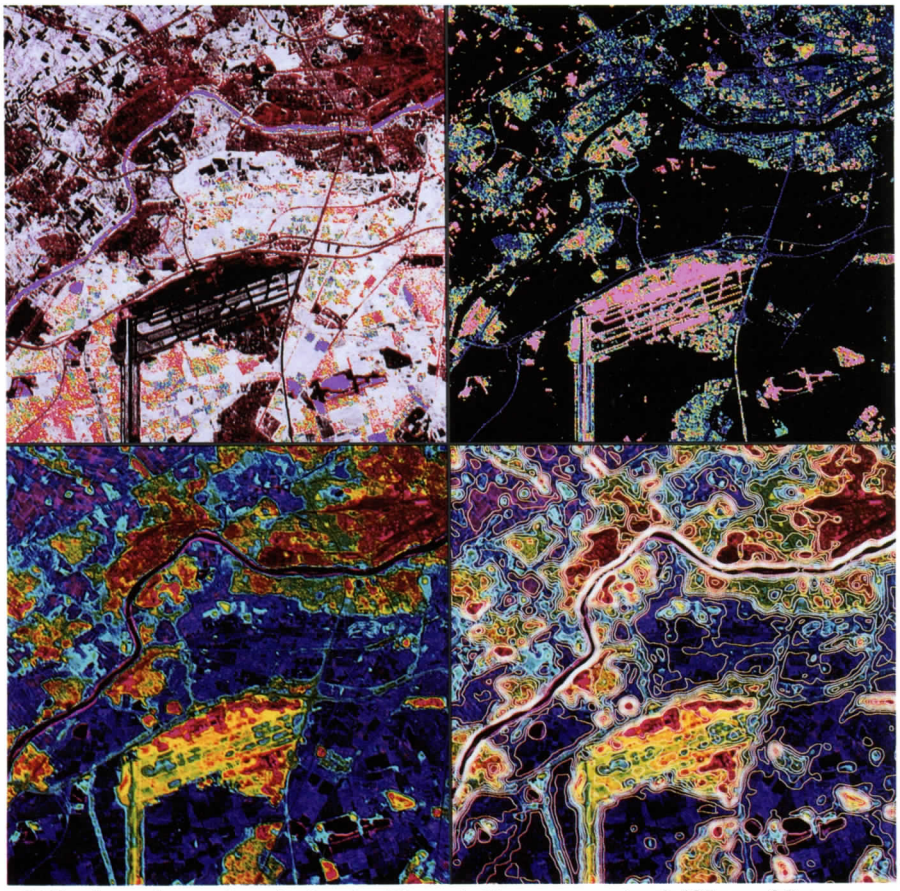
GAF Specialists Offer Wide Array of Image Processing Skills

GAF Ltd., the Company for Applied Remote Sensing, is an independent, internationally active consulting company with a good reputation for providing computer-based solutions using remote sensing data and GIS techniques. Headquartered in Munich, the capital of the German state of Bavaria, the company started its operations in October 1985. It has been the EOSAT sales representative for Germany since 1986.

GAF's specialties are digital image processing, creation of geographic information systems (GIS), conventional and digital cartography, image interpretation and classification, imagery integration and data management techniques. The company boasts of a highly motivated staff and state-of-the-art hardware and software. GAF guarantees excellent quality and sophisticated project management.

Six years of extensive consulting and engineering work in remote sensing applications has produced a multidisciplinary team of specialists in forestry, land use, agriculture, geology, geophysics, geography and cartography. The specialists have both national and international experience. To fill any gaps in its expertise, the company brings in internationally acknowledged experts and scientific institutions that can cover every aspect of an application.

GAF is active in various fields of geosciences and cartography. Major undertakings since its founding include numerous studies and application projects and the development of satellite data-processing software. The range of projects comprises geology (mineral resources, ground water, engineering ecology), agriculture, geomorphology and soil sciences, environmental studies, climatology mapping and all stages of regional planning. The company has performed projects and studies for the German technical aid bodies, the German Ministry of Research and Technology, the German aerospace establishment, the European Space Agency and the European Economic Commission. GAF projects are located all over the world.



GAF enhanced a portion of a Landsat Thematic Mapper scene (path 195, row 25) to perform microenvironmental studies of an urban area. See text for descriptions.

The accompanying images are examples of GAF image processing and enhancement. In the area shown are the Main River, Wiesbaden (southeast corner), the Frankfurt International Airport, western Frankfurt (center eastern edge) and the Taunus Mountains (diagonally from northeast corner).

Upper right: By ratioing and masking, vegetated areas in the scene have been blacked out, a technique useful for studies of urban areas. The colors identify paved and covered areas, distinguished by degree of cover, from magenta (maximum cover) to blue-violet (minimum cover). This information is useful for predicting areas of heavy storm runoff.

Upper left: In a study virtually the opposite of the one at right, this image employs Landsat data to measure the vitality of a type of plant. Red-violet and black areas are built-up, white areas are vegetation, and violet indicates water and cloud shadow. Red, yellow, green and blue spots have information about the age and vitality of broadleaf tree stands. This kind of enhancement is of great help for tree evaluation in sparsely planted areas.

Lower left: Thermal data has been overlaid on a reflective band, with violet representing the cool areas and red the hot regions.

Lower right: Isothermal contour lines have been laid over the data on the lower left image to separate brightness temperature differences of 1K. This microclimate information helps in estimating thermal stress.

GAF is one of Europe's leading distributors of Landsat data. Its affiliate,

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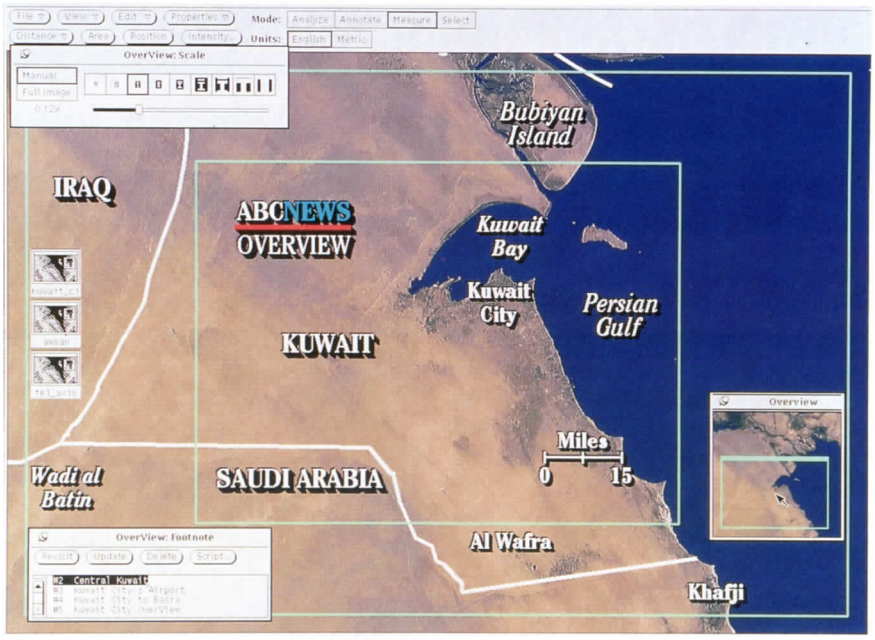
Scitor Software Puts Landsat Data on the Air

A Sunnyvale, Calif., company has introduced Landsat imagery to television broadcasting by developing computer software for on-air analysis.

The interactive software, designed by Scitor Corporation, is the first packaged application that enables newscasters to illustrate their reports with on-air manipulation of satellite imagery. Besides the satellite data, the OverView software requires a workstation computer, a video converter, a mass data-storage system, and auxiliary video support.

OverView was first used by ABC News to report on the Persian Gulf War. The satellite imagery, comprising Kuwait and bordering areas of Saudi Arabia and Iraq, was a mosaic of Landsat Thematic Mapper (TM) scenes acquired in September and December 1990 and January 1991. The OverView hardware Scitor installed at ABC News headquarters in New York consisted of a Sun SPARC station IPC, a Photron 64000 video converter, and a Scitor memory tower. Output from the installation was directed into ABC's video routing network to anchor Peter Jennings in New York or to military analyst Tony Cordesman in Washington. While Cordesman discussed the strategic situation in the military theater, the imagery was magnified, highlighted or annotated.



OverView system permits broadcasters to annotate, measure, analyze and overlay graphics on Landsat satellite imagery and give locational context to a news report.

ABC demonstrated the usefulness of the TM imagery after the ground phase of the war began on February 23. OverView identified the Kuwait borders fortified by the Iraqi occupiers because the TM sensors showed where the ground had been excavated. The multispectral TM images later were used to delineate the natural corridor the Iraqis had to follow as they escaped from Kuwait. The images also were magnified for close-up views of key areas. Since the Landsat data had information on geographic position, OverView was used to locate specific areas or measure distances within the Landsat image.

Scitor is marketing the OverView system to telecasters in the United States and Canada. The company says the application is user-friendly and can be mastered within a few hours. ❖

DOWNLINKS, *from page 2*

state agency or organization involved in a state-sponsored project.

For more information, contact Shawana Johnson, North American director of marketing and sales, at EOSAT's Cleveland office, 216-642-1446, (fax) 216-642-3080.

EOSAT Marketing Southern Africa Data

EOSAT customers now have direct access to Landsat data for much of southern Africa under a new agreement with the operator of the South African Landsat receiving station, the Satellite Applications Center, Division of Microelectronics and Communications Technology in Pretoria.

Signed in December, the agreement gives EOSAT marketing rights to Landsat data acquired by the station. EOSAT has similar marketing arrangements with ground stations in China, Japan and Australia.

Volcano Research Wins EOSAT Award

The 1991 EOSAT Academic Merit Award has been granted to Adrian Edmundo Benitez for use of Landsat TM data to study the environmental impact of the Hudson Volcano eruption in Argentina. Mr. Benitez, a student at National University of Lujan, Argentina, will receive a $4,400 data grant.

This award, administered by the Society for Latin American Remote Sensing Specialists (SELPER), is one of two academic awards EOSAT grants each year. The other is chosen through the American Society for Photogrammetry and Remote Sensing (ASPRS). ❖

GAF Specialists

from page 7

Teledetección Aplicada (TdA) in Madrid, serves the Iberian Peninsula and Latin America, offering the same type of services as GAF. TdA was founded in 1990 as a joint venture of GAF and Minas de Almadén y Arrayanes S.A., a mining and exploration company that produces and markets mercury, tin, tungsten, lead, silver and gold.

With its new Cirrus LC3000 laser film writer system, GAF can produce high-quality positive or negative photographic transparencies from customer digital tapes. ❖